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Valuing Rural Dexterity: Experiential Funds of Knowledge, Science Education, and Rural Kids

Amanda Morales
University of Nebraska-Lincoln, amanda.morales@unl.edu

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ABSTRACT—One's sense of *place* is tied inextricably to one's identity. Who we become as adults is closely connected to our interweaving of *experience* over time and how we come to understand the world and ourselves relative to it. These informal and organic interactions within the specific environmental contexts of our childhoods can seem insignificant and inconsequential, particularly given that children's imaginative explorations, informal investigations, and authentic observations of ecological phenomena present in their daily lives are often not acknowledged by or valued within formal educational settings. In this essay, I use Gonzalez, Moll, and Amanti's (2005) *Funds of Knowledge* construct as a lens to interpret the ways in which the education of rural children could, but usually does not, intentionally draw on the routine, outside-of-school agrarian experiences and social, network-embedded wisdom that rural children bring with them to science classrooms. Furthermore, I problematize how the growing emphasis on globalization within formal education has increased tendencies to overlook and devalue some children's lived experiences with their immediate environment. Finally, I provide considerations for educators and parents fostering the development of children's scientific funds of knowledge, particularly in rural contexts.

Key Words: funds of knowledge, informal science education, place-based education, rural brain drain, rural students

The crisp fall air fills my lungs. As I race out the back door and jump off our cement slab porch, I hear the old screen door slam shut behind me. I stumble, struggling to zip my coat, as I run to meet my cousins, Erma and Becky, who are waiting on the dirt road, down the hill. The crunch of my feet as they fall on the frost-covered grass mixes with the sounds of the wind and my heart beating in my chest. We are heading to the railroad tracks for the day. Like dozens of times before, with a sleeve of crackers and a thermos of water, we are ready for another day of adventure.

My Saturday journey with my cousins through the pastures beyond the edge of town was not unlike that undertaken by many others in my town, our region, and likely across the Great Plains. As children growing up in the 1980s, in a rural farming community on the High Plains of western Kansas, we spent hours upon hours outside, climbing the railroad bridges, playing in the mud along the banks of the creek, biking the dirt trails in the wooded areas along the "draw" (watershed), traversing electric cattle fences, and exploring the junkyard behind our grandmother's house. These experiences shaped me, grounded me, and inspired me to engage my curiosities with the physical world in meaningful ways.

One's sense of *place* is tied inextricably to one's identity. It is not an uncommon question to ask someone when you meet, "Where are you from?" expecting that the answer is salient to how that person should be understood. Who we become as adults is closely connected to our sense making regarding *experiences*—social, emotional, spiritual, physical, and geographic—that is, how we come to understand the world and ourselves relative to it. These informal and organic interactions within the specific environmental contexts of our childhoods—the "geographies of childhood" (Orellana 2009)—educate us, although they can be treated as insignificant and inconsequential in formal education settings. Contemporary schooling in the Great Plains (as elsewhere) does not often acknowledge or seek to connect to children's imaginative explorations, informal investigations, and

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authentic observations of ecological phenomena present in their daily lives (Greenwood 2011).

Over the years, authors such as Rachel Carson, Joseph Cornell, and Richard Louv have documented the powerful connections between nature and children's cognitive development as well as the fundamental importance of maintaining and nurturing these connections. In their book *The Tree of Knowledge: The Biological Roots of Human Understanding*, Maturana and Varela (1998) describe cognition "not as a representation of the world 'out there' but rather as an ongoing bringing forth of a world through the process of living in it" (13). The recursive relationship between action and experience is circular and inseparable, meaning "every act of knowing brings forth a world" . . . "all doing is knowing, and all knowing is doing" . . . and "every reflection brings forth a world" (26). The bringing forth of knowledge is "a human action by someone in particular, in a particular place" (27).

Yet, sadly, formal education's tendency to overlook and devalue children's lived experiences with nature and their immediate environment has only increased as modern technology and media have advanced. David Greenwood (2011) indicates that prior to the formalization and industrialization of public schools, "Local and regional culture and geography were the contexts and the 'texts' through which people learned who they were, and what they needed to know to live" (632). While many aspects of public schooling have remained unchanged (for better and for worse), Greenwood (2011) also asserts that the increased emphasis on globalization that drives (and standardizes) educational policy has made the local contexts in which we live much less central to the content of curriculum.

Children in rural agrarian regions (like me and my cousins) have long spent a great deal of time outside in the elements, playing and/or working the land alongside our families. Yet despite this rich engagement, it is often difficult for these children to see connection between their everyday experiences within their immediate physical world and their schooling. So, with time, distance grows between the student and the authentic observations and curiosity-led explorations of their childhood. They are rarely taught to see their out-of-school experiences as "funds of knowledge"—the ideas, strategies, and wisdom about how to negotiate the ordinary challenges and opportunities of everyday life (Gonzalez et al. 2005)—to draw from when asked to engage in formalized educational inquiry. Greenwood and other place-based educators assert that the synthetic, formulaic, and sterilized versions of learning that often occur in schools today neglects *place* and thereby "produce[s] a profound illiteracy of both nature and culture" (Greenwood 2011) in children. To phrase this in the terms of both the introductory anecdote and the premise of this journal, the Great Plains (or the more particular, like the High Plains of Kansas) has disappeared from the formal curriculum.

I wonder what the costs are of a standardized and standards-oriented de facto national curriculum. Who is hurt by school systems' discounting of local knowledges? How does that impact not only how children connect to their community, state, and region, but also how students, teachers, parents, and administrators are understood? In this piece, I provide interpretation and illustration of these dilemmas through my experiences working with both rural and urban children in both informal and formal educational settings over the past twenty years, all in the Great Plains. Contextualized within the literature on place-based education and informal learning, I share anecdotes from my time as an informal science museum educator and as a faculty member in teacher education. I then provide considerations for educators and parents fostering the development of children, particularly in rural contexts.

What I Noticed, What I Wondered

This article's main task is not to draw conclusions from my own happily remembered childhood. Rather, that anecdote and the rest of the introduction are intended not only to name a problem (the lack of the ways schooling attends to children's negotiation of and mastery of local context) but to also present another possibility (the often joyous, hands-on, not-fully-scripted-ahead-of-time child impulse for exploration) for how context can be re-harnessed for learning. Those two points lead me to want to describe a more recent and more professional part of my biography and to share from that an observation about rural kids, or at least Great Plains rural kids. It is my recollection from when I worked in educational programming at the Fort Worth Museum of Science and History that rural children engaged with hands-on learning tasks differently than their suburban and urban counterpoints.

In my role as an informal science educator, I did school- and community-based programming with children and families for more than six years. (*Informal* here

means neither impromptu nor unorganized; rather, consistent with the field of science education, it references teaching and learning efforts outside the framework of formal school environments.) Located in the heart of the city, during my time there the Fort Worth Museum of Science and History hosted nearly a million patrons a year. Though it drew a broad range of visitors from all over the country and the world, a large portion of the school-age patronage came from the thriving regional field trip program. I had the fortune of facilitating literally hundreds of hands-on science demonstrations and explorations of scientific phenomena with K–12 students each year.

With a qualitative curiosity and an affinity for observing human behavior, I took special interest in the learning processes that took place in the physical spaces of the museum (e.g., in the outdoor dinosaur excavation site, the physics of light and sound gallery, etc.). I spent time every day in the galleries interacting with children, teachers, and parents, observing their behaviors and interactions with the exhibits and each other. More specifically, I paid attention to the ways in which they made meaning of their experience within a given learning environment (and the associated phenomena they were exploring), through both verbal and nonverbal communication.

It was in these ongoing observations that I came to notice patterns and differing dispositions toward scientific phenomena across groups. Time and again, I found that rural agrarian students who came to the museum with a school group engaged in the spaces differently than students who came from local urban and suburban communities. For example, in the hands-on physics gallery named ExploraZone, urban and suburban students' initial comfort level for manipulating the physical exhibits tended to be lower than for rural students. They seemed more hesitant and unsure of what exactly one was *supposed* to do with the materials and contraptions they saw. To be sure, these exhibits were designed to be open-ended with little signage, allowing for multiple entry points for learning. The exhibits included things like pulleys, levers, wheels, switches, pumps, motors, and ropes. For the most part, once interactions with the materials and/or contraptions were modeled for the students (by me, a peer, or a teacher), the suburban and urban kids engaged readily, but rural kids usually started without that modeling.

With rural children, I typically witnessed a *common-sense* approach in their actions and interactions. Once they were assured that the exhibits were there to be explored and manipulated, they took command of the equipment and contraptions with an assured physicality and adroitness (not in the sense of haphazard roughness or rowdiness). In a very short time, they could reach a level of finesse in manipulating a given contraption, seeming to understand the ways in which the object(s) *should* move or interact in the physical space. Furthermore, I found they were more likely to engage with exhibits longer than many of the urban and suburban students, and they were less likely to give up if the scientific phenomena involved were unfamiliar to them.

Similarly, when I did formal interactive demonstrations at the museum and regional events (e.g., with liquid nitrogen or dry ice) I engaged students up close, asking them to share and describe what they were seeing, feeling, hearing, smelling, and in some cases tasting. In these learning contexts, rural students seemed quite in tune with their senses, frequently asking insightful, inquiry-based questions related to specific observations they were making of the phenomena in front of them. And while rural students were often less likely than suburban students to have familiarity with formal scientific terms or to be able to give textbook definitions of the specific concepts being explored, they were able to describe what they were observing with precise detail, often picking up on subtle relationships and patterns.

In my direct interactions and conversations with my rural agrarian students, I realized that they often were pulling directly from their prior experiences as they were making meaning of their new experiences. Their daily interactions with the physical world in their agrarian community often served as natural anchors for building more formalized, robust, and complex understandings of scientific phenomena. In efforts to further build understanding, I began more formally drawing on their culturally contextualized background knowledge as rural kids in the Great Plains, living and working on or near farms. I was able to scaffold their learning of properties of matter, freezing and thawing, weathering, oxidation, soil composition, magnetism, photosynthesis, pressure, the water cycle, and so on, all because, as I knew, many of them had direct experiences with these concepts in their local environments. For example, when discussing properties of water (e.g., freezing and thawing or condensation and evaporation), many students could relate to avoiding frozen water pipes in the winter or condensation on condenser coils. When exploring oxidation, many students had seen and touched

rust on metal equipment and barbwire fences and could describe its characteristics in detail.

Children who worked in the fields, or had parents who did, also often had a deeper appreciation and respect for the weather and meteorology, as it closely impacted the daily lives of their families (such as crop yields based on variations in precipitation and the effects of hail and tornados). In relation to biological science, they often could provide many examples from their experience to illustrate the food chain, such as the value of farm cats for keeping mice populations low, the importance of ladybugs for eating the aphids that spread viruses among crops, and hunters for keeping the deer and pheasants (who eat seeds and destroy fields) from overpopulation.

All these are real-life examples of authentic science in the lives of rural Great Plains children and families. These experiential funds of knowledge were and continue to be echoed in the instructional conversations I have had with students in formal contexts as well. Whether in K–12 classrooms or in STEM (science, technology, engineering, and mathematics) education or teacher preparation courses at the university level, rural students, when given the opportunity, would draw on their environmental and vocational experiences. Yet, I wonder, where do these contextualized ways of knowing fit into our standardized curricula? I wonder how often they are acknowledged or leveraged in the classroom or how well we are preparing teachers to mine rural students' scientific funds of knowledge as resources in their formal science teaching. Sadly, it seems that opportunities for children to see their lived experiences in rural environments represented in their formal schooling continue to shrink, as teacher autonomy and flexibility lessens and curriculum standardization increases (Fernandez and Lutz 2015). Is it any wonder then that rural communities continue to struggle to keep their youth highly engaged in education, or that rural youth increasingly lack a sense of connection to the land, despite the vital need for them to remain and invest in their communities upon graduation?

Standardized Curricula for Nonstandard Realities

In their 2001 book, *Hollowing Out the Middle*, Maria Kefalas and Patrick Carr coined the phrase "rural brain drain" to describe how small, historically agrarian or mining-oriented communities (particularly in the Midwest) consistently each year endure the loss of talented youth who leave in pursuit of perceived broader opportunities in urban environments. In this important text, they document the devastating effects that the "loss of educated and talented young people, the aging of the population, and the erosion of the local economy" (ii) in the Heartland has had and will have on the region and the nation as a whole. Examples they give include that "much of the nation's natural resources and the world's food comes from this region," and that with all the wind-energy and food-security initiatives in the Great Plains, sustainment of this region is vital. They poignantly describe the Midwest as the country's "ground zero for the rolling out of the green economy and sustainable agriculture" (ii), illustrating its value well into the next century.

As a native of the rural Great Plains and as an educator in this region for many years, I have seen the impact that the hollowing out has had on the region. More specifically, I know the challenges that the associated social and economic tensions have created for rural schooling. In reviewing the literature focused on the realities faced in rural communities, Irvin et al. (2012) found that "youth attending low-income rural schools are four times less likely to meet adequate yearly progress than other rural youth" (73), and while urban youth have high dropout rates, rural students in poverty drop out at more than twice the national average, tend to hold lower educational aspirations, and are less likely to complete college than peers in urban environments.

Therefore, when making sense of why rural communities struggle to keep their youth, I fully acknowledge the complex and multilayered social, historical, economic, and structural factors involved. However, I can't help but see formal education's lack of context responsiveness as partially responsible, especially if we think back to the ways in which education often fails to honor and incorporate the contextualized experiences of rural children. When children are taught, directly and indirectly, that: (1) education is some formally defined collection of sequentially structured concepts that all kids must learn in lockstep, (2) their daily rural experiences have little or no currency in their immediate educational contexts or future professional prospects, and (3) that education is their "ticket out" of their "backwards" rural reality and into the "real world," we devalue everything that life on the Great Plains embodies.

Within this deficit perspective, educational systems underestimate or are blind to the dimensions of freedom and responsibility (akin to Jefferson's rural ideal of the autonomous, self-regulating yeoman farmer) that can emerge in rural or nature-connected childhood experience. The remoteness often associated with rural life in the Great Plains presents both place-specific challenges and opportunities. As illustrated in the above vignettes, youth's experiences doing daily chores and weathering the elements that come with each season, foster a sense of responsibility to and respect for the land. The often-sparse population and sometimes limited access to amenities, services, and commercial goods in these regions create situations that necessitate youth's development of resourcefulness, certain manual skills, and creative problem-solving in ways that urban or suburban experiences are unlikely to develop. Given their exposure to perhaps a broader array of challenges and responsibilities (e.g., needing to learn to drive a grain truck during harvest at the age of 12, or to run a welding torch at the age of 15), rural youth are more disposed to having diversified skills to do a lot of practical and technical things at a relatively young age. This concept, which I call *rural dexterity*, might be seen as context-specific; however, I believe these developed aptitudes have not only physical but also physiological, emotional, and cognitive characteristics, and when acknowledged, understood, and leveraged in the classroom, they can be powerful tools for learning across lifespans and for career development.

Challenging Neoliberal Notions of Globalized Identities

As part of the larger national (and international) discourse about education, there has been a strong push for developing "career readiness" as well as "global perspectives" and "intercultural competence" among students, and understandably so. However, amid this heightened emphasis on globalization, many educational policy makers have missed the point entirely, basing policy decisions on a neoliberal agenda. Instead of teaching children the value of broadened global perspectives, which lead to greater cultural dexterity, intercultural competence, and global citizenship identities, national political rhetoric overwhelmingly promotes global education with superficial, capitalistic intentions, implying a singular purpose—to prepare students to be more competitive in the global marketplace.

Greenwood (2011) argues that although globalization has an "enormous impact on our thought, language, action, and the organization of social institutions such as schools" (638), he claims that the complexity of *place* provides a natural conceptual counter to the global society argument. He states that the idea of place-based education is "not only to develop a complex understanding of a place, but to develop a complex understanding of places and the relationship between place, past, present and future." (638). He further claims that it is in many ways the antidote to the reification of globalization because it pays attention to the impact of globalization on the places where people and species actually live (638).

In this regard, I believe that place-based education is a moral imperative. More specifically, having one's geographic identity or identities (developed through one's contextualized experiences within physical places) acknowledged, valued, and incorporated into one's learning is a human right. In their piece exploring the use of space and place in thinking about social justice in rural education, Roberts and Green (2013) aptly describe the problematic nature of how, throughout educational history, "rural and urban schools have been simultaneously compared and considered as if they were essentially the same" and that "this dualism, of being different yet the same, reveals how space and place are ill-considered notions" in educational policy (765).

Green and Letts (2007) have a name for this highly problematic tendency among many policy makers and educational researchers: *geographical blindness*. Because education reforms are typically influenced and driven by those in positions of power, this blindness in turn recursively benefits privileged social groups who are characteristically more "metropolitan in their orientation" (Roberts and Green 2013, 767). The use of the metropolitan as the idealized norm, results in the social construction of rural schools and communities as backwards and deficient. Such a view of education, Roberts and Green (2013) argue, "reinforces the social marginalization of rural schooling and the notion of the rural as both 'real' and the imagined *other*" (767).

As described, these dangerous deficit perspectives toward rural schools, rural communities, and rural knowledge have socioeconomic, political, and historical roots. Not only do these inherently unjust trends perpetuate systemic devaluing and erasure of nuanced regional knowledge, they also prevent the inclusion of cultural ways of knowing unique to the increasingly diverse populations living in and (im)migrating to the Great Plains.

Rurally Rooted Funds of Knowledge

So, what can be done? We can and should take an asset-based, funds-of-knowledge approach to interpreting and defending rural identities or, to again tie into the theme of this special issue, of Great Plains identities. As illustrated in the accounts I provide in the first half of this article, we can construct a new paradigm for interpreting and envisioning quality science education for rural children. This paradigm would be deeply rooted in students' lived experiences in this region. It would clearly articulate to students that their lives here matter—that place and context *matters*. Yet this science knowledge does not exist in isolation. These same experiences with doing chores, with playing by the draw, and with repairing old equipment also have social studies and humanities dimensions. If science matters because it matters here, it matters to what I know, do, have done, and/or am curious about, then this holds true not just for science.

As we account for both the constraints and the affordances that living in the Great Plains provide students—through in-tune understandings of who they are and the ways in which they engage with the physical world—we can bring the curriculum to life. This is possible by activating their experiential funds of knowledge, and leveraging them in the development of more formalized understandings of scientific concepts and processes. We can exponentially increase the relevance of education and the students' sense of connection between their current realities and their future potentialities.

In a study by Jacobs et al. (1998) that focused on rural girls with demonstrated talent in science, the authors found that "the positive attitudes of parents and peers, success in science classes, and access to science activities and mentoring appear to be critical to females' continued interest in science" (684), yet self-perceptions, prior experiences, and the value of the task or goal to the student also matter in shaping their engagement in science. If we can envision a place-based education in the Great Plains that honors rural students' roots and contextualized experiences while helping them to see the ways in which they are connected to a larger global community, we can foster pride in a positive rural identity that does not assume they need to leave it in order to lead a meaningful and successful life.

Discussion and Implications

I would argue that, in order to realize this type of education, a systemic look at education across an array of contexts and levels is necessary. One area for education research and changed education praxis is to consider how to recover our region's place-based education at both schools and informal education environments, like the Fort Worth Science and History Museum and environmental education centers (see Albracht this volume), acknowledging that the latter may be much more successful currently in this regard and may have much to teach the schools. Informal education organizations tend to see learning as something visceral (to be experienced in mind and body) and to see "curriculum" as something three dimensional (to be touched, smelled, and explored). This positions them as ideal partners to learn from as we envision more context-based approaches in schools.

In teacher education, better integration of rural students' funds of knowledge could lead to many positive outcomes. However, in order to understand and teach to rural realities, both those designing teacher education programs and those being prepared through them must know those realities better. This notion challenges teacher education programs to foster and strengthen their connections with communities more directly, implementing mechanisms for the voices of community members to be heard and consistently considered in teacher education. For example, in relation to localized science knowledge, institutions of higher education that have a land-grant mission and/or extension programs have a natural connection to rural communities that should be leveraged more frequently in partnership development, curriculum development, and preservice field experiences.

We also need to reconsider our efforts toward recruitment and retention of teachers in and from rural contexts. As we know, hiring and keeping high-quality teachers in rural schools is a national challenge (Monk 2007), one felt acutely in the Plains (Hare and Heap 2001) and especially in the areas of math and science. Teachers who come to rural districts from urban and suburban environments tend to stay for only a short time, often claiming (in addition to limited resources) that remoteness and cultural differences were some of the biggest issues for them in finding their place in rural communities (Tye 2016).

Sindelar et al. (2018) found that when given the option, rural administrators "have been shown to prefer local candidates over out-of-area or out-of-state candidates" (15). Perhaps this reflects a kind of pragmatism learned from the arrival and departure of new teachers from nonrural backgrounds. But it may also demonstrate a recognition of the fact that rural teachers (when encouraged to use it in their instruction) can bring contextualized *cultural capital* to the job that urban and suburban teachers have not developed. Again, this points to the fact that place and context matter in teaching and learning.

Taking this into account, we can leverage to our advantage not only what we know experientially about rural funds of knowledge in the Great Plains, but also what we know from the research about rural students elsewhere. For example, it is evident that when looking at postsecondary options, graduates may consider it important to stay near family, friends, and supportive ties (Hektner 1995), especially if they are the first person in their family to pursue higher education (Kim et al. 2016). Therefore, leaders in hard-to-staff districts in the Great Plains have implemented a variety of initiatives such as "grow-your-own-teacher" programs that recruit local youth, providing tuition and housing assistance. They have also started paraeducator career-ladder options and comprehensive tiered mentoring and induction (Zuber and Berg-Jacobson 2017; American Institutes for Research 2018). Ideally, teacher preparation programs could work in partnership with rural school districts, regional community colleges, and community members in recursive ways to learn from and inform each other of localized needs and perspectives in order to more effectively recruit, prepare, and retain highly qualified rural teachers who are able to enact their contextualized funds of knowledge in service to their communities.

On a personal level, as a teacher educator and scholar of teacher education in this region, this centering of *place* has challenged me to look inward and reflect on my own praxis. Are my rural preservice teachers leaving their preparation program with the understanding that Great Plains kids are familiar with Great Plains contexts (from their out-of-school experiences) but often find little echo of that experience in school? Am I modeling these pedagogies with my rural preservice teachers in ways that are meaningful and transferable? Are they prepared to use their own similar informal learning experiences to help their rural students utilize their funds of knowledge and rural dexterity as tools for engagement, knowledge expansion, and skill development? To these ends, I have tried to make my moments of authentic connection with fellow rural students purposeful and integrated components in my curriculum instead of happenstance or serendipitous anomalies. By focusing on my preservice teachers' biographies (their sociocultural, linguistic, cognitive, and academic resources) (Herrera 2016), I am more effectively able to make authentic connections with my rural students (through our shared rural experiences) and to draw on their funds of knowledge during instruction.

I am often reminded of the old adage that *people teach the way they are taught*. If this holds true, then increases in *our* understanding of place as teacher educators in the Great Plains, and shifts in *our* praxis that utilize rural ways of knowing, have great potential to improve K–12 instruction in similar ways.

Amanda R. Morales (amanda.morales@unl.edu), Henzlik Hall 26, University of Nebraska–Lincoln, Lincoln, NE 68588-0355, is an assistant professor in the Department of Teaching, Learning, and Teacher Education at the University of Nebraska–Lincoln and a fellow of the Center for Great Plains Studies. Born and raised in western Kansas, she has lived all her life in the Great Plains, including stints in Fort Worth, Texas, and Manhattan, Kansas. Her research interests include multicultural education, diversity and teacher workforce development, and the relationships between high schools, community colleges, and four-year institutions.

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